

Division of Compensation Analysis and Support Technical Basis Document for the Electro Metallurgical Company Niagara Falls, New York		Document Number: DCAS-TKBS-0007 Effective Date: 02/15/2011 Revision No.: 00 Page 1 of 8
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RECORD OF ISSUE/REVISIONS

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
02/14/2011	02/15/2011	00	Changes Battelle-TBD-6001 Appendix to a standalone document. Change is primarily format only. Does not incorporate review comments.

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1.0 Introduction

Technical basis documents and site profile documents are not official determinations made by the National Institute for Occupational Safety and Health (NIOSH) but are rather general working documents that provide historic background information and guidance to assist in the preparation of dose reconstructions at particular sites or categories of sites. They will be revised in the event additional relevant information is obtained about the affected site(s). These documents may be used to assist NIOSH staff in the completion of the individual work required for each dose reconstruction.

In this document the word “facility” is used as a general term for an area, building, or group of buildings that served a specific purpose at a site. It does not necessarily connote an “atomic weapons employer facility” or a “Department of Energy [DOE] facility” as defined in the Energy Employees Occupational Illness Compensation Program Act [EEOICPA; 42 U.S.C. § 7384l(5) and (12)]. EEOICPA defines a DOE facility as “any building, structure, or premise, including the grounds upon which such building, structure, or premise is located ... in which operations are, or have been, conducted by, or on behalf of, the Department of Energy (except for buildings, structures, premises, grounds, or operations ... pertaining to the Naval Nuclear Propulsion Program)” [42 U.S.C. § 7384l(12)]. Accordingly, except for the exclusion for the Naval Nuclear Propulsion Program noted above, any facility that performs or performed DOE operations of any nature whatsoever is a DOE facility encompassed by EEOICPA.

For employees of DOE or its contractors with cancer, the DOE facility definition only determines eligibility for a dose reconstruction, which is a prerequisite to a compensation decision (except for members of the Special Exposure Cohort). The compensation decision for cancer claimants is based on a section of the statute entitled “Exposure in the Performance of Duty.” That provision [42 U.S.C. § 7384n(b)] says that an individual with cancer “shall be determined to have sustained that cancer in the performance of duty for purposes of the compensation program if, and only if, the cancer ... was at least as likely as not related to employment at the facility [where the employee worked], as determined in accordance with the POC [probability of causation¹] guidelines established under subsection (c) ...” [42 U.S.C. § 7384n(b)]. Neither the statute nor the probability of causation guidelines (nor the dose reconstruction regulation, 42 C.F.R. Pt. 82) define “performance of duty” for DOE employees with a covered cancer or restrict the “duty” to nuclear weapons work (NIOSH 2010).

The statute also includes a definition of a DOE facility that excludes “buildings, structures, premises, grounds, or operations covered by Executive Order No. 12344, dated February 1, 1982 (42 U.S.C. 7158 note), pertaining to the Naval Nuclear Propulsion Program” [42 U.S.C. § 7384l(12)]. While this definition excludes Naval Nuclear Propulsion Facilities from being covered under the Act, the section of EEOICPA that deals with the compensation decision for covered employees with cancer [i.e., 42 U.S.C. § 7384n(b), entitled “Exposure in the Performance of Duty”] does not contain such an exclusion. Therefore, the statute requires NIOSH to include all occupationally-derived radiation exposures received at covered facilities in its dose reconstructions for employees at DOE facilities, including radiation exposures related to the Naval Nuclear Propulsion Program. As a result, all internal and external occupational

¹ The U.S. Department of Labor (DOL) is ultimately responsible under the EEOICPA for determining the POC.

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radiation exposures received at covered facilities are considered valid for inclusion in a dose reconstruction. NIOSH, however, does not consider the following exposures to be occupationally derived (NIOSH 2010):

- Background radiation, including radiation from naturally occurring radon present in conventional structures
- Radiation from X-rays received in the diagnosis of injuries or illnesses or for therapeutic reasons

The following information from the Department of Energy's Office of Health, Safety and Security EEOICPA Find Facilities webpage defines the EEOICPA covered periods for the Electro Metallurgical Company.

Site: Electro Metallurgical Company
Location: Niagara Falls, New York
Covered Period: 1942-1953

This document contains a summary of the description of the site as well as the Atomic Energy Commission activities performed there, and provides the technical basis to be used to evaluate the occupational radiation doses for EEOICPA claims.

2.0 Site Description and Operational History

The Electro Metallurgical Company uranium operations were located south of Pine Avenue and east of its intersection with Packard Road, Niagara Falls, New York. Available information indicates that all uranium operations (including the business office, lunchroom, and shipping areas) were conducted within a single building. The building was a one-story cinder block and wood structure, which measured approximately 50 feet by 219 feet located in an area now occupied by the current Building 166 of the Union Carbide Corporation building complex (UMETCO). Initial furnace operations for uranium processing began in April 1943 (AEC 1951) and at full operations three shifts per day were run.

3.0 Process Description

The plant was to take uranium tetrafluoride and convert it to uranium metal by heating the uranium salt with magnesium and casting into 110-135 kilogram ingots. Contract MED W-7405-Eng-14 initiated design, engineering, construction, and operation of the plant (UMETCO). Uranium production at the Electro Metallurgical Company began in April 1943 and appears to have run continuously until August 1946. Uranium production operations were suspended from August 1946 to October 1947 (UMETCO). Operations continued from October 1947 until production was stopped on September 28, 1949 and placed in standby on September 30, 1949.

In April 1950, the UF₄-to-metal plant was reactivated for casting zirconium metal sponge into ingots for the Navy Critical Requirement program. The zirconium metal operations did not pose a radiological hazard other than exposure to residual uranium remaining since cessation of uranium operations in 1949. Uranium handling from January –June 1951 may have occurred

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based on a contract that: "... directed Union Carbide to conduct research and development of methods of forming metal that would minimize unnecessary machining, finishing, and waste". Although the contract is not specific, the metal involved is presumed to be uranium.

The AEC involvement with the site ended when contract W-7405-Eng. 14 expired on June 30, 1953 (UMETCO). No documentation was found indicating there were other sources of radiation at Electro Metallurgical during the covered period between 1942 and 1953.

Operational and standby periods are outlined in the table below. For the purpose of dose reconstruction, time periods in which no uranium work was occurring are defined as standby even though other processes were occurring.

Table 1: Electro Metallurgical Operating History

	Start	Stop
Operations	04/01/1943	08/31/1946
Standby	09/01/1946	09/30/1947
Operations	10/01/1947	09/30/1949
Standby	10/01/1949	01/01/1951
Operations	01/01/1951	06/30/1951
Standby	06/30/1951	06/30/1953

4.0 Internal Dose

Air samples were collected in various areas of the plant in 1948 and 1949. These air samples were combined with time motion studies of various tasks to obtain a daily weighted average of the air concentration inhaled. For this exposure estimate, these tasks were broken up into three categories of tasks: Operators, Supervisor/Laborers, and Others. The "Operator" category is for personnel that routinely handled uranium or operated uranium processing equipment. The "Supervisor/Laborer" category is for personnel that were routinely present in the uranium handling areas but did not handle uranium or uranium processing equipment on a routine basis. Examples of people fitting this category are foreman, guards, maintenance personnel, and janitors. Laboratory technicians and chemists also fit this category because they routinely handled uranium but not in production quantities. The "Other" category is for personnel that did not routinely enter the uranium production areas. Examples of people fitting this category are office personnel and store room attendants.

The daily weighted air samples were divided into these three categories. The distribution from each group of air samples was determined. Because there were a limited number of samples the 95th percentile of each distribution will be assigned. Because this represents a bounding assumption, the value will be assigned as a constant. These values were used to estimate ingestion intakes per the requirements of OCAS-TIB-0009 (NIOSH 2004).

Uranium operations were suspended three times during the covered period at the site. Since operations were suspended, it is unlikely anyone routinely handled uranium or uranium processing equipment. Also, the uranium inventory was likely reduced if not eliminated. Therefore, during those times, all personnel will be assigned dose based on the "Other" category.

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This is intended to account for internal dose that would be received from residual uranium contamination that may have remained. Also, uranium operations did not start until April 1943. Therefore, no internal dose will be assigned prior to that date.

For internal dose estimates, the uranium will be considered to be type M or type S solubility. The dose estimate should be based on the one that produces the highest dose. The time weighted averages indicated a normal work day of 515 minutes, 8 hours of work plus 20 minutes for lunch and 15 minutes in the locker room to change clothes. The dose estimate is based on this 515 minutes per day, 5 days per week and 50 weeks per year.

Table 2: Daily Intakes of Uranium

Job Category	Operation Phase	Radionuclide	Inhalation (dpm/day)	Ingestion (dpm/day)
Operators	Operations	U-234	60661	1178
Supervisors/Laborers			8159	158
Others			473	9.2
All	Standby		473	9.2

5.0 External Dose

Film badge results taken between June 1948 and September 1949 were found for operators at Electro Metallurgical. While some reports included operator names and job titles, others did not. In order to include all the data, all badge readings were combined into one large population. Badges were issued weekly and both photon (gamma) and electron (beta) radiation were measured.

The data set was assumed to be lognormally distributed. When analyzed, the geometric mean of the distribution was 20.06 mr/week photons and 64.43 mr/week beta. The geometric standard deviations for the weekly readings were 2.30 and 3.13 respectively.

Since the badge results that did have job descriptions associated with them represented a mixture of job types, it is possible that assigning the distribution would underestimate some workers, while overestimating others. Therefore, personnel will be assigned to one of three categories: Operators, Supervisors and Laborer, and Others. Operators are those that routinely worked directly with uranium. The Supervisors/Laborers category is for personnel that were routinely in the areas where uranium operations occurred but were not routinely handling uranium directly. Maintenance personnel fall into this category. The "Others" category is for personnel that did not routinely enter the uranium production areas. Examples of personnel fitting this category are office personnel and store room attendants. Operators are assigned the 95th percentile of the annual dose. Supervisors and Laborers are assigned the 50th percentile of the distribution. The Others category is assigned the 5th percentile of the distributions. Since these represent bounding estimates, the dose is assigned as a constant.

Uranium operations were suspended three times during the covered period at the site. Since operations were suspended, it is unlikely anyone routinely handled uranium or uranium processing equipment. Also, the uranium inventory was likely reduced if not eliminated.

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Therefore, during those times, all personnel will be assigned dose based on the “Others” category. This is intended to account for external dose that would be received from residual uranium contamination that may have remained. Also, uranium operations did not start until April 1943. Therefore, no external dose will be assigned prior to that date.

Table 3: Annual External Dose

Job Category	Operation Phase	Whole Body Dose ^(a) (mrem/year)	Shallow Dose ^(b) (mrem/year)
Operators	Operations	3934	21030
Supervisors/Laborers		1003	3221
Others		256	493
All	Standby	256	493

(a) Applied as Photons 30-250 keV. Whole body photon doses are to be converted to organ doses using the Exposure to Organ Dose Conversion Factors (US DHHS 2007).

(b) Applied as Electrons > 15 keV.

6.0 Occupational Medical Dose

A memo reviewing the medical program at Electro Metallurgical was written by the MED in 1945 (AEC 1945). The memo recommended pre-employment, annual and termination X-rays. No information regarding occupational medical dose was found in any of the site research or Computer Assisted Telephone Interview materials. Information to be used in dose reconstructions, for which no specific information is available, is provided in ORAUT-OTIB-0006, Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures (ORAUT 2005). The assumed frequency in this document is PA chest X-ray for pre-employment, annual, and termination examinations between the years 1942 and 1953 (the covered period). Annual organ doses are entered into the NIOSH-IREP program as the annual dose due to an acute exposure to photons (E=30-250 keV). The distribution is assumed to be normal with a standard deviation of 30%.

7.0 References

AEC 1945, Memo from B.J. Mears, Captain, Medical Corps., to Area Engineer, Tonawanda Area, Tonawanda, New York, May 4, 1945 [SRDB Ref ID 21849].

AEC 1951, Report by the Manager of New York Operations Office and the Director of Production, *The Production of Uranium Feed Materials*, May 22, 1951 [SRDB Ref ID 4125].

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NIOSH (National Institute for Occupational Safety and Health) 2004, *Estimation of Ingestion Intakes, Rev 0*, OCAS-TIB-0009, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio.

NIOSH 2010, *Radiation Exposures Covered for Dose Reconstructions Under Part B of the Energy Employees Occupational Illness Compensation Program Act, Rev 1*, OCAS-IG-003,

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